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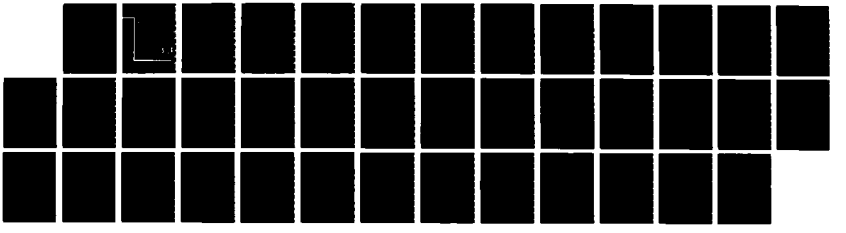

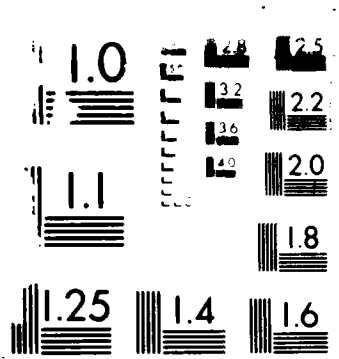
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AIRCREW TASK SURVEYS: SELECTION CRITERIA FOR LOW-COST TRAINING TECHNOLOGY APPLICATIONS

Bernell J. Edwards

OPERATIONS TRAINING DIVISION
Williams Air Force Base, Arizona 85240-6457

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This paper documents the first phase of a research and development effort to obtain opinion data from Air Force operational aircrews to support the selection of training tasks as candidates for the development of several high-technology, low-cost, part-task trainer demonstrations. The overall goal of the effort is to develop and combine scientifically derived, advanced part-task training methods with state-of-the-art training technology. Several surveys of aircrews who fly tanker, transport, or bomber type aircraft were conducted to elicit their opinions regarding training issues which bear on the matching of task characteristics with low-cost training technology. Survey results provide a general guide to the selection of appropriate tasks for further analysis.

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Bernell J. Edwards

OPERATIONS TRAINING DIVISION
Williams Air Force Base, Arizona 85240-6457

Reviewed and submitted for publication by

Thomas H. Gray
Acting Technical Advisor
Operations Training Division

This publication is primarily a working paper. It is published solely to document work performed.

SUMMARY

Selected members of the tanker, transport and bomber aircrew community of the Air Force were surveyed to obtain their opinions relative to several training issues which appear to bear on the application of low-cost training devices to support the training of aircrews on specific, mission-related tasks performed in the aircraft. This investigation is the initial phase of an effort to develop, validate, and demonstrate the application of advanced part-task training methods and technology for aircrew training. Results from the surveys were used to identify classes of tasks for further analysis which will ultimately lead to development of prototype part-task trainer demonstrations.

PREFACE

This effort represents a portion of the research and development (R&D) program of the Air Force Human Resources Laboratory for Technical Planning Objective 3, the thrust of which is Aircrew Training Effectiveness. The general objective of this thrust is to identify and demonstrate cost effectiveness in training Air Force/aircrew members. More specifically, the effort was part of the R&D conducted under the Aircrew Training Effectiveness subthrust, which has as its goal the provision of a technology base for improving the effectiveness and efficiency of training combat aircrews. The present effort was conducted as a part of Work Unit 1123-25-01, Special Function Trainer Technology. The research was accomplished in cooperation with the Military Airlift Command (MAC) and Strategic Air Command (SAC) in accordance with terms of Memoranda of Agreement with the two organizations specifying the accomplishment of aircrew surveys to identify part-task training R&D requirements. The author acknowledges the cooperation and support of this effort by individuals within both commands. Specifically acknowledged is the assistance of Lt Col Joe Burch, and Mr. Don Barkley, HQ MAC/DOT; Major Irving Boswell and Major Terry Matthews, 93 BMW/DOS (SAC); and Mr. Charles Hamilton, AFMPC/YPS. These individuals made substantial contributions to the development and administration of the survey instruments used in this effort.

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I. INTRODUCTION

This paper documents the first phase of a research and development (R&D) effort to support improved training of Air Force aircrews. The objective of this first phase of the effort was to survey operational aircrews in order to obtain relevant data about the tasks they perform during aircraft missions. The surveys described in this paper provide initial evidence to support the selection of training tasks for the development of several high-technology, low-cost part-task trainer demonstrations. The overall goal of the effort is to demonstrate state-of-the-art hardware/software configurations as vehicles for advanced, scientifically valid part-task training.

The surveys were designed to elicit aircrew member opinions regarding training issues which bear on the matching of task characteristics with training technology, particularly low-cost technology. These issues are: (a) adequacy of training provided in current programs for specific tasks; (b) relative difficulty of tasks; (c) level of training device cost/complexity required to support training for tasks; and (d) appropriateness of high-technology, low-cost alternatives to support training for tasks.

In this report, for purposes of orderly exposition, a more comprehensive discussion of the utilization of survey data, and their implications, will be deferred until after the surveys themselves have been fully described.

Approach to Surveys

The development and administration of the aircrew task surveys was a cooperative effort between the Air Force Human Resources Laboratory, Operations Training Division (AFHRL/OT), and the user commands (Military Airlift Command (MAC) and Strategic Air Command (SAC)). Decisions concerning which aircraft missions/tasks to include in the surveys, the design of questionnaire content, aircrew sampling requirements and provisions, survey administration, data analysis and reporting of results were reached jointly between AFHRL/OT and users. Authorization to conduct surveys within the Air Force was obtained from the Air Force Military Personnel Center (AFMPC/YP).

Aircraft Types

The scope of the surveys was based on obtaining a reasonable cross-section of the range and types of tasks performed during aircrew missions. In the first phase, which was limited to tanker, transport, bomber (TTB) aircraft, the following aircraft were selected for general representativeness, with the concurrence of HQ SAC, Deputy Commander, Operations Training (DOT) and HQ MAC DOT, respectively: B-52 and KC-135 (SAC); C-130 and C-141 (MAC). It was also determined jointly that each aircrew position for each aircraft would be included in the surveys.

Aircrew Mission Task Lists

Development of the questionnaires began by obtaining task listings for each aircrew position for each of the aircraft selected. These lists were obtained from SAC and MAC as official master task lists. Because of space limitations in the questionnaire, the tasks comprising the mission

were described generally rather than in detail. Task listings in the questionnaires comprised the entire mission, but each task listed subsumed a considerable number of subtasks which were not specifically listed. Tasks were listed chronologically as accomplished during the mission.

Aircrew Sampling

The objective of sampling was to obtain reasonable representativeness of opinions of the aircrew member population by aircraft type. However, for purposes of administrative control and in order to expedite data collection, the most efficient method was for HQ MAC/DOT and HQ SAC/DOT to administer surveys via lines of authority to operational wings and training squadrons. In order to obtain representativeness, the distribution of questionnaires was balanced across wings and squadrons. A goal of a minimum 20% sample of aircrews for each aircraft and each aircrew position was attempted for each of the surveys.

Design of Surveys

The intent of the survey was to elicit an opinion from each aircrew member relative to each of the major tasks performed during the mission. In the questionnaire, the respondent was required to answer four questions about each task listed. Each question was constructed to assess a selection factor judged by researchers as important in determining the relative appropriateness of tasks as candidates for part-task training research. In the format of the questionnaire, these questions appear on page 3, opposite a listing of the mission tasks for each aircrew position. A copy of the questionnaire for the B-52 radar navigator/navigator position is included in Appendix A. This questionnaire is typical of those used for all aircraft types and crew positions surveyed. In each case, the respondent was asked to rate factors relative to tasks by placing a numbered response (corresponding to rating scales provided with the questions on page 3) in the appropriate column and row for each task listed on page 2. For example, Question A, which asks the crew member to rate the adequacy of training provided for the task, has a response scale ranging from 1 (very inadequate) to 5 (very adequate). The questionnaire was formatted such that when the respondent had answered Questions A, B, C, and D for all tasks which comprise his/her mission, a composite picture of opinions in terms of the four task selection factors would emerge on page 2.

Task Selection Factors

The selection factors, as represented in Questions A through D, were generally in an ascending order of specificity and pointed toward assessing the appropriateness/utility of special function trainers (SFTs) to support training for tasks. An SFT was defined in Question C as a microcomputer-based desk top trainer. The rationale underlying each of the questions was as follows:

Question A asked the respondent to rate the adequacy of training for each task in the current training program, on a 1 to 5 response scale. The intent was to assess how well the aircrew member perceived he/she had been trained to perform each task. The purpose was to identify tasks for which improved training appears warranted.

Question B addressed the relative difficulty of tasks, defined as amount of training time required by the crew member to learn to perform the task relative to other tasks in the mission. The scale ranged from 1 (much less than average [amount of time]) to 5 (much more than average). Tasks judged more difficult would be more likely to be selected as candidates for part-task training.

Question C asked the respondent to estimate the minimum level of training media required to support training for the task. It assumed the respondent was familiar with the training capabilities of each of the devices/methods listed as options. The options, listed from highest to lowest in terms of cost, ranged from 1 (aircraft) to 8 (workbooks, regs, study guides, texts, etc.). The intent was to determine if the tasks were appropriate for the general area of part-task training. As a general rule, if the task was judged to be supportable at levels 5 through 8, it was considered a potentially selectable training task.

Question D asked for an estimate of how useful an SFT (defined in Question C) would be for training any part of the task. The scale ranged from 1 (not useful at all) to 5 (very useful). The question was designed to elicit specific consideration of the "new technology" option. It assumed that aircrew members were well enough aware of microcomputer-based technology to form opinions of its potential for training.

Implications of Responses

None of the factors taken singly could provide a sufficient basis for selecting candidate tasks. However, taken collectively, these data provide an opinion "profile" on each task in order to identify and prioritize tasks for further analysis.

Open-Ended Response Items

Page 4 of each questionnaire contained five open-ended questions to be answered at the option of the respondent. The purpose of these questions was to provide an opportunity for aircrew members to express opinions about the training program independently from task-specific questions. The method used to classify these responses is described later in this paper.

Coordination of Questionnaire Content/Format

The format and content of all questionnaires were essentially the same except for the tasks listed on page 2, which were specific to each crew position and aircraft. Draft questionnaires were forwarded to HQ MAC/DOTR and HQ SAC/DOTP for examination and revision by subject-matter experts. Following concurrence on format and content, each questionnaire was forwarded to AFMPC/YP for approval and authorization to be used as a survey instrument. The surveys were assigned an AFMPC control number which appeared on the cover of the questionnaires. Questionnaires were then reproduced in quantity and forwarded to MAC and SAC for administration.

II. METHOD

Survey Administration

The administration of each survey was accomplished by either HQ MAC/DOTR or HQ SAC/DOTP, as appropriate. Two hundred fifty copies of each questionnaire were distributed among units within the operational wings of these MAJCOMs. An attempt was made to distribute questionnaires in a balanced fashion across units. Survey control officers were assigned at each participating unit to distribute, control, and collect questionnaires. Typically, 5 to 7 days were allowed for the respondent to complete the questionnaire and return it to the unit control officer. All questionnaires were collected by HQ MAC/DOTR or HQ SAC/DOTP and returned to AFHRL/OT for data analysis.

Data Analysis

Data from each of the surveys were computer analyzed and tabulated to show the spread of responses across the scale for each of the questions (A - D) for each aircrew member position and aircraft. An example of one such table is shown in Table 1.

Table 1. Percentage of Responses to Scaled Items by B-52 Radar Navigator/Navigators for Each of 23 Mission-Related Tasks to Question A of Questionnaire

A. How do you rate the adequacy of training for this task in the current B-52 program?

very inadequate 1 | inadequate 2 | neither adequate nor inadequate 3 | adequate 4 | very adequate 5

Mission tasks	Very inad. 1	Inadeq. 2	Neither Inad./ad. 3	Adeq. 4	Very Adeq. 5	M	SD
1	1.0	4.0	6.1	60.6	28.3	4.11	.77
2	1.0	1.0	5.1	59.2	33.7	4.23	.69
3	3.0	3.0	11.1	50.5	32.3	4.06	.91
4	1.0	2.0	3.1	60.2	33.7	4.23	.70
5	2.0	4.1	3.1	60.2	30.6	4.13	.82
6	2.0	3.1	3.1	60.2	31.6	4.16	.80
7	7.1	20.4	18.4	36.7	17.3	3.37	1.20
8	1.0	4.1	12.4	55.7	26.8	4.03	.81
9	2.0	7.1	15.3	57.1	18.4	3.83	.89
10	9.3	8.2	19.6	44.3	18.6	3.55	1.16
11	2.0	4.1	5.1	61.2	27.6	4.08	.82
12	1.0	2.0	6.1	63.3	27.6	4.14	.70
13	2.0	2.0	7.1	58.2	30.6	4.16	.88
14	3.1	3.1	8.2	55.1	30.6	4.07	.89
15	2.0	9.2	11.2	59.2	18.4	3.83	.91
16	1.0	1.0	12.2	61.2	24.5	4.07	.71
17	1.0	1.0	10.2	63.3	24.5	4.09	.69
18	11.9	18.3	20.4	33.3	16.1	3.24	1.26
19	11.3	18.6	25.8	36.1	8.2	3.15	1.18
20	11.2	18.4	26.5	33.7	10.2	3.18	1.21
21	1.0	2.0	6.1	68.4	22.4	4.09	.67
22	1.0	1.0	4.1	71.1	22.7	4.13	.62
23	1.0	2.1	6.2	63.9	26.8	4.13	.70

The table shows the percentage of B-52 radar navigator/navigator respondents who selected each point on the response scale of Question A for each listed task. In addition, a mean rating for each task is provided. By inspecting the data table, tasks can be ranked according to the perceived adequacy of training. As indicated in Table 1, task 19 was the task for which training was perceived to be least adequate, followed by tasks 20 and 18.

For each question, only those tasks were identified and ranked for which the percentage of ratings most clearly indicated relevance for selection. The same process was repeated for Questions B, C, and D to obtain task rankings. For nearly all tables, it was necessary to rank

no more than 5 or 6 tasks, due to the spread of response data. Following the ranking of tasks according to this method, a composite of the rankings was constructed by ranking tasks across the four questions, as shown in Table 2, which provides a clear picture of the relationships among the ranked (prioritized) tasks. Obviously, of most interest would be clustering of the rankings of factors on specific tasks; and tasks for which two or more factors ranked highly were of interest as candidates for selection. For the radar navigator navigator tasks, clustering of rankings appears for tasks 18, 19, and 20, which ranked first, second, or third on all four criteria. Task 19 ranked first on Questions A, C, and D and second on B. Task 20 ranked second on A, C, and D and third on B. Task 18 ranked third on A, C, and D and first on B. Other tasks on the table showed no substantial clustering effects.

Table 2. Results of Rankings of B-52 Radar Navigator/Navigator Tasks According to Relevance of Responses to Four Selection Factors (Questions A, B, C, and D)

B-52 Tasks: Radar Navigator/Navigator	A	B	C	D	Comments
1. Perform aircraft preflight/documents/check aircraft equipment					
2. Perform before exterior inspection					
3. Perform exterior inspection/check condition bomb bay					
4. Perform interior inspection			7		
5. Perform after engine start procedures					
6. Perform before takeoff procedures					
7. Perform minimum interval takeoff, formation flying and enroute cell	4				
8. Perform inflight terrain avoidance functional check					
9. Perform air refueling rendezvous procedures		4			
10. Perform coded switch sequence enabling procedures			4	4	
11. Complete weapons preparation for release checklist				5	
12. Perform before initial point checklist			5		
13. Perform synchronous bomb run		5			
14. Perform missile launch					
15. Complete abort/retained weapons nuclear checklist					
16. Perform climb after low level checklist			6		
17. Perform withdrawal checklist					
18. Perform emergency/abnormal offensive avionics station procedures	3	1	3	3	
19. Analyze/resolve abnormal/unsafe weapons status indications	1	2	1	1	
20. Analyze/resolve weapons release malfunctions	2	3	2	2	
21. Perform before descent checklist					
22. Perform descent and before landing checklist					
23. Perform after landing duties					

The same process was carried out across all questionnaire data for all surveys. For purposes of simplification, the results of this analysis are summarized below by aircraft and aircrew member position. The number and percentage of individuals who completed and returned questionnaires distributed are indicated for each.

III. RESULTS

Task Selection

As a result of the analysis described above, the following tasks were identified (and prioritized) as candidates for further consideration and analysis:

C-141 Aircraft

Pilot/Copilot (N = 137, 54%)

1. Compute takeoff, climb, and cruise data
2. Prepare for air refueling procedure
3. Operate navigation system
4. Operate pneumatic system
5. Operate hydraulic system

Navigator (N = 73, 29%)

1. Perform airdrop calculations
2. Perform inflight fuel management
3. Operate inertial navigation system
4. Operate station-keeping equipment
5. Operate communications system
6. Operate aircraft system
7. Interpret pilot instruments

Flight Engineer (N = 121, 48%)

1. Perform special/all-weather procedures
2. Perform airdrop mission procedures
3. Perform communication/navigation equipment operations
4. Operate fuel savings advisory system
5. Operate electrical systems operations
6. Perform weight and balance procedures

Loadmaster (N = 102, 41%)

1. Perform radio operations
2. Operate airdrop equipment
3. Perform gear malfunction requirements
4. Compute DD Form 365-4, A Weight and Balance Clearance Form F--Transport
5. Compute roller load limitations

C-130 Aircraft

Pilot Copilot (N = 178, 71%)

1. Compute takeoff and landing, climb, cruise and descent data
2. Perform mission planning/preparation
3. Operate airdrop equipment
4. Operate station-keeping equipment

Navigator (N = 105, 42%)

1. Fix aircraft position using pressure pattern methods
2. Fix aircraft position using celestial methods
3. Maintain inflight log and chart
4. Compute MAC Form 512, The Computed Air Release Point, data for all load types
5. Interpret pilot's horizontal situation indicator

Flight Engineer (N = 105, 42%)

1. Verify weight and balance data
2. Perform special and all-weather operations
3. Compute takeoff and landing, climb, cruise, and descent performance data

Loadmaster (N = 107, 43%)

1. Determine winch capabilities
2. Computer cargo load shoring requirements
3. Determine load placement
4. Compute weight and balance data
5. Compute extraction system limitations
6. Determine personnel airdrop equipment requirements

B-52 Aircraft

Pilot/Copilot (N = 104, 42%)

1. Perform before-leaving aircraft checklist/procedures
2. Perform calibration procedures
3. Perform after-landing checklist/procedures
4. Perform before-lineup procedures

Radar Navigator/Navigator (N = 99, 40%)

1. Analyze/resolve abnormal/unsafe weapons status indications
2. Analyze/resolve weapons release malfunctions
3. Perform emergency/abnormal offensive avionics station procedures

Electronic Warfare Officer (N = 93, 37%)

1. Perform defensive procedures
2. Perform penetration duties
3. Perform low-altitude procedures

Gunner (N = 115, 46%)

1. Perform fire control system checkout procedures
2. Perform strange-field training procedures
3. Perform fighter intercept exercise procedures

KC-135 Aircraft

Pilot/Copilot (N = 171, 68%)

1. Compute takeoff, climb, and cruise data
2. Compute penetration descent/approach/landing data
3. Perform system malfunction analysis procedures
4. Perform emergency war order mission preparation

Navigator (N = 132, 53%)

1. Perform celestial navigation
2. Perform system malfunction and analysis procedures
3. Operate with abnormal equipment
4. Perform air refueling procedures

Boom Operator (N = 152, 68%)

1. Perform weight/balance calculations
2. Perform celestial navigation procedures

Data for Open-Ended Response Items

The open-ended questions on page 4 of each questionnaire provided the opportunity for aircrew members to express personal opinions about the training program, exclusive of the task-specific training data on pages 2 and 3. In order to tabulate these comments, researchers developed a pool of response-coded categories and prepared short phrase descriptors for each category. Phrase descriptors were reviewed to ensure that the list of descriptors adequately summarized the range and content of the written responses across each aircraft aircrew position. In some cases, several behavioral scientists were used to verify the adequacy of the descriptors. Researchers then re-read each questionnaire and coded the written responses using the validated response categories. The coded responses were then input to a computer and tabulated by aircraft and aircrew position. Although the page 4 questions were identical for all positions and aircraft, the results for each were unique. The tabulated results are contained in Appendix B.

IV. DISCUSSION

Application of Current Findings

As discussed earlier, each of the tasks listed in the questionnaires represents a considerable variety of subtasks comprised of various behavioral elements. Not only does each task subsume a large number of subtasks but, in turn, each subtask may be comprised of numerous elements representing diverse behavioral components.

No attempt has been made at the present level of analysis to assess the behavioral dimensions of tasks nor to subdivide them into subtasks or elements. More detailed analysis must await concurrence of the user as to the appropriateness and priorities of tasks selected on the basis of the present aircrew opinion data. Once final task selection is made, a detailed analysis will ensue, including the following: (a) subdivision of tasks into operationally oriented subtasks; (b) division of subtasks into behavioral elements; (c) determination of primary loadings of tasks on behavioral dimensions such as perceptual, cognitive, and psychomotor components, and (d)

determination of which subtasks and/or behavioral elements can be most effectively supported through the application of SFT technology/methodology. This effort will encompass in-depth behavioral analysis and development of an SFT of advanced hardware/software design for each MAJCOM user. The trainers will be developed jointly with the MAJCOM, which will be involved throughout all phases of development. Software features will include real-time simulation of tasks or part-tasks, performance measurement in the form of feedback and scoring, guidance to the student (tutorial courseware), and instructor-controlled training scenarios. Hardware will be configured with capabilities for advanced computer graphics, videodisc, student responding modes, and other peripheral devices to support specific behavioral requirements. Trainers developed under this effort will be used initially as technology demonstrations. They will be validated first in an experimental environment in which selected part-task strategies will be manipulated to optimize training effectiveness. Final validation of trainer prototypes will be accomplished in the operational training environment in cooperation with the appropriate MAJCOM; once validated, the trainers will be turned over to the command for follow-on applications.

Task Selection Outcomes

Four task selection factors were represented in the questionnaires. As described previously, the loadings on these factors were used to select tasks for further discussion and analysis in dialogue with the appropriate MAJCOM. Examination of the selection factors showed the most pronounced loading or clustering occurred on several navigator and electronic warfare officer tasks. Clustering of factors was much less pronounced for pilot, copilot, and flight engineer tasks in general and for B-52 gunner and KC-135 boom operator tasks in particular. Pilot opinions strongly favored the use of aircraft or simulators for training most tasks listed in the questionnaires. Tasks performed by navigators and/or electronic warfare officers were considered generally more suited to the capabilities of SFTs because of the requirements for information display, and task interaction, and the perceptual and cognitive aspects involving computations, manipulation of instruments, and similar operations.

Examination of the nature of each of the selected tasks reveals some fairly obvious correpondence between requirements for training and the capabilities of SFTs.

Special Function Trainer (SFT)

The SFT represents a level of training device technology which bridges the gap between academics (including computer-assisted instruction [CAI]) and flight simulators. The SFT is built around a specific, real-time task, with emphasis on engaging the student in the task at the earliest point possible in the training program. SFT capabilities include: (a) providing the essential fidelity dimensions (real time as required) of the task; (b) providing effective guidance, practice, and feedback to the student; (c) permitting self-assessment of proficiency on the task as part of the feedback process; and (d) providing necessary student records and training management resources. The SFT's task-centralized approach affords wide latitude to the training manager in incorporating the system within the program. For example, an SFT can be used as an adjunct to an existing CAI program. Also, one SFT hardware configuration may accommodate a variety of training tasks through multiple software packages.

Training Power of the System

The specific characteristics which constitute the training power of the SFT are: (a) real-time simulation of the task and thus, (b) an abundance of time on task for each student to achieve proficiency prior to flight simulator and/or aircraft phases of training, and (c) direct

assessment of student achievement through performance-scoring software. The latter characteristic is essential for the learner, to assess his/her own rate and level of performance, and for the training manager, to determine when the learner is ready for the next phase of training. Various other features can be designed into the system software. One is the capability for the instructor to vary the level of difficulty of the task or to modify the elements of the training scenario.

Task-Technology Match

In general, the tasks selected for further study and analyses tended to fall into three categories: (a) procedurally oriented operation of aircraft subsystems and checklists, (b) monitoring and computational tasks associated with subsystem operations, and (c) planning and decision making associated with the mission.

Training fidelity requirements for these tasks appear to be within the range of capabilities which characterize the SFT technology. For example, provision for essential information, cues, task practice, and feedback seems achievable with microcomputer technology. Operation of aircraft subsystems, in many cases, can be simulated using an SFT. For example, the graphics system could be used to represent the various displays and controls of the aircraft subsystem, and the student could simulate interaction with the controls via a touch screen, mouse, digi-pad, joystick, or other control. Software could be developed to simulate the task in real time, if required, or at a more basic level, to simulate the step-by-step aspects of system operation in non-real time. The training of procedures could be accomplished at several levels of difficulty, beginning with fundamentals and progressing through normal mission scenarios to abnormal operations and emergency procedures. The hardware configuration for SFTs is sufficient to achieve acceptable levels of task fidelity for these procedural tasks. Levels of task difficulty are primarily a function of the sophistication of the software.

Acquisition of computational, mission planning, and decision-making skills can be readily supported by SFTs. Simulation fidelity requirements for these types of tasks are, in many cases, less demanding than those for aircraft subsystem operations. The information (knowledge) and concept acquisition associated with the performance of aircrew tasks can be easily supported with SFTs. However, knowledge level requirements, in many cases, may be more efficiently treated and tested through individual reading materials and exercises. For example, for knowledge acquisition, pretraining is most effective when the student is given the opportunity to apply knowledge in a mission-related, operational context.

To summarize, there appears to be a useful correspondence between the tasks tentatively selected using the survey data and the potential of the SFT technology to train the tasks effectively.

Aircrew Member Comments

One of the major opinions expressed in the open-ended response portion of the questionnaires was the need for more realistic, combat, or hostile environment training. This opinion surfaced in nearly all of the questionnaires across aircraft and crew member positions and was mentioned particularly frequently by C-130 pilots copilots and flight engineers, C-141 pilots copilots and navigators, and B-52 pilots/copilots (see Appendix B). Other frequently mentioned training needs (listed in approximate order of frequency) were as follows: (a) greater access to simulators (KC-135 pilots/copilots and boom operators; C-130 pilots/copilots and navigators; C-141 loadmasters, pilots/copilots, and flight engineers); (b) more efficient use of flight time (KC-135

navigators, pilots/copilots, and boom operators; C-130 flight engineers, pilots/copilots, and loadmasters; B-52 pilots/copilots); (c) better training technology/training materials (KC-135 pilots/copilots, boom operators, and navigators; C-130 pilots/copilots and navigators; B-52 navigators and gunners); (d) more flight time (KC-135 pilots/copilots, navigators, and boom operators; C-141 pilots/copilots and navigators); (e) better fidelity and maintenance of simulators (B-52 electronic warfare officers; C-141 pilots/copilots and loadmasters; B-52 pilots/copilots; KC-135 pilots/copilots); (f) better use of simulator time (KC-135 navigators and pilots/copilots; B-52 pilots/copilots; C-130 pilots/copilots); (g) integration of weapon system training into the training syllabus (KC-135 navigators; B-52 electronic warfare officers, navigators, and gunners); (h) use of SFTs or CPTs (C-141 pilots/copilots, flight engineers, and navigators; KC-135 navigators); (i) better use of instructors (KC-135 pilots/copilots and navigators); (j) more emergency procedures training (KC-135 navigators and pilots/copilots; C-130 flight engineers); (k) more crew coordination training (KC-135 navigators and pilots/copilots; B-52 gunners); (l) more hands-on training (KC-135 boom operators; C-141 loadmasters); (m) more aircraft systems training (C-130 flight engineers; KC-135 pilots/copilots; C-141 navigators); and (n) more off-station (strange field) training (KC-135 pilots/copilots and navigators).

The opinions of C-130 and C-141 aircrew members expressed relative to SFTs reflect a growing awareness of the capabilities of this type of technology, possibly engendered by recent experimental applications of SFTs by MAC.

V. CONCLUSIONS

The results of the present effort have been systematically tabulated and examined, and an initial identification of tasks has been accomplished based on the opinion data. Now required is a dialogue with the user MAJCOMs, in which the survey data can serve as a point of departure for discussions whereby other selection criteria can be added and a final priority can be assigned by the commands to the appropriate tasks. These tasks will then be extensively analyzed and used in experimental environments in which various part-task training methods are employed to determine how to subdivide and reintegrate tasks during training. Part-task training methodology will then be applied to the development and evaluation of several prototype SFTs. The ultimate objective is to demonstrate optimal mixes of training devices and training methodology as a means of improving aircrew training while reducing training costs.

APPENDIX A: AIRCREW TASK QUESTIONNAIRE SAMPLE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEBRASKA 68113

B-52 RADAR NAVIGATOR/NAVIGATOR TASK SURVEY

Your responses to this questionnaire are important. They will contribute to improved B-52 training. The purpose of this questionnnaire is to determine your perceptions about training for tasks you perform. Data will be used to prioritize program improvements, not to justify reduced flying hours or simulator buys. Questions relate to adequacy of training, training difficulty, task media matching, and potential use of microcomputers.

Enter ONLY the information requested below:

Assigned Wing _____

Primary Mission _____

Total flying hours _____ Total B-52 flying hours _____

Hours per month currently flying _____

All responses to this survey are anonymous. Please answer all items candidly and completely. Comment freely. If you feel important tasks have been omitted, list them.

PLEASE OPEN THE QUESTIONNAIRE

USAF SCN: 84-16B

INSTRUCTIONS. For each task listed below answer questions A.B.C.D. shown on the facing page. Select the desired response number for each question and write it in the appropriate column (A.B.C.D) and row on this page.

Example: Task: Calibrate equipment — A B C D: 4 5 3 3

B-52 TASKS: RADAR NAVIGATOR/NAVIGATOR

	Questions (Next pg) A	B	C	D	Comment
1. Perform A/C prefit, docmnts, Chk A/C eqpmnt					
2. Perform before exterior inspection					
3. Perform ext inspec, chk condtn bomb bay					
4. Perform interior inspection					
5. Perform after engine start procedures					
6. Perform before takeoff prcdrs					
7. Perform MITO, formation flying and enroute ctl					
8. Perform inflight TA functional chk					
9. Perform air refueling rendezvous prcdrs					
10. Perform OSS enabling prcdrs					
11. Complete weapons preparation for release chklst					
12. Perform before IP chklst					
13. Perform simultaneous bomb run					
14. Perform missile launch					
15. Complete abort, retained weapons nuclear chklst					
16. Perform climb after low level chklst					
17. Perform withdrawal chklst					
18. Perform emergency/abnormal DAS prcdrs					
19. Analyze resolve abnrml unsafe wpns status indctns					
20. Analyze resolve weapons release malfunctions					
21. Perform before descent chklst					
22. Perform descent and before landing chklst					
23. Perform after landing duties					

List additional tasks here (optional)

QUESTIONS

A. How do you rate the adequacy of training for this task in the current B-52 program?

very inadequate	inadequate	neither adequate nor inadequate	adequate	very adequate
1	2	3	4	5

B. Compared to the other tasks within the mission, how much training time did you require to learn to perform this task?

much less than average	less than average	average	more than average	much more than average
1	2	3	4	5

C. Devices/methods below are ranked from high to low by estimated overall training cost. Which of these could provide minimally adequate training for this task at least cost, assuming the device/method is available as needed?

1. Aircraft
2. Weapons Systems Trainer (WST) B-52 real time simulation plus full-color visual system)
3. Operations Flight Trainer (OFT (WST less visual system)
4. Cockpit Procedures Trainer (CPT) (basic aircraft subsystems instrumentation/functions/controls)
5. Special Function Trainer (SFT) (microcomputer-based desk top trainer with interactive touch-screen graphics, self-paced procedures and task-specific skills testing)
6. Classroom instruction
7. Mockups, training aids, audiovisuals, etc.
8. Workbooks, Regs, study guides, texts, etc.

D. How useful would a Special Function Trainer (described in C5 above) be for providing training for any part of this task?

not useful at all	slightly useful	moderately useful	useful	very useful
1	2	3	4	5

Comments:

Please provide brief written responses for these questions:

1. What changes in the current training program do you feel are needed to insure the highest possible levels of aircrew combat readiness?

2. How can available flying hours be more effectively used for various phases of the current training program?

3. How can available simulator hours be more effectively used within the program?

4. What additional equipment or methods not now available is/are needed to enhance training effectiveness?

5. Please make other suggestions or comments about improving the training program

APPENDIX B: SUMMARIES OF OPEN-ENDED RESPONSES

Table B-1. SAC B-52 - Pilot/Copilot (N = 104)

	Category	Page 4 questions 1	2	3	4	5	T
1.	More realistic training	32	12	1	3	3	51
2.	Better use of simulator time (weapon system trainer)	14	1	27	4	2	48
3.	No change/positive comment	5	12	9	3	5	34
4.	Better maintenance on simulator/WST/cockpit procedures trainer	1	1	17	8	4	31
5.	More efficient use of flight time	5	19	0	2	1	27
6.	More hostile environment training	19	2	1	2	1	25
7.	More aerial refueling and low level	5	15	0	0	0	20
8.	Shorter local missions	5	12	0	0	3	20
9.	Eliminate long strategic training range complex runs - more local	3	14	1	0	1	19
10.	Better training technology/materials	0	0	3	13	3	19
11.	Fewer students; more instructors	5	4	1	2	5	17
12.	Better scheduling	1	7	4	2	3	17
13.	Add simulator with visual system	0	1	6	9	1	17
14.	More electronic warfare officer training	12	3	0	0	1	16
15.	More crew coordination training	4	0	5	1	2	12
16.	More tactical missions	6	3	1	1	1	12
17.	More enemy weapons/tactics training	6	0	0	4	2	12
18.	Better pre-mission training	4	0	3	3	2	12
19.	More variety in aircraft training	5	4	1	0	1	11
20.	More strange field/low level	3	7	0	1	0	11
21.	More simulator time	2	0	7	1	1	11
22.	Other administrative change	1	1	2	5	2	11
23.	Terrain avoidance calibration and flying	5	1	1	3	1	11
24.	More cell training	4	4	0	1	0	9
25.	More flying time	9	0	0	0	0	9
26.	More aircraft system training	2	0	2	1	2	7
27.	More/better emergency procedures training	1	0	5	0	0	6
28.	More flight planning	2	0	0	1	1	4
29.	Other methods/procedures	0	1	0	3	0	4
30.	Increase copilot responsibility	2	1	0	0	1	4
31.	More attention to new individuals	1	1	0	1	0	3
32.	More proficiency hours	1	1	0	1	0	3
33.	Other content changes	0	2	0	0	0	2
34.	Better continuity in training program	1	0	0	0	1	2
35.	More/better academics	0	0	1	0	0	1

Table B-2. SAC B-52 - Radar Navigator/Navigator (N = 99)

	Category	Page 4 questions 1	2	3	4	5	T
1.	Other	9	5	3	18	6	41
2.	Integrate weapon system trainer into syllabus	14	2	12	10	2	40
3.	No change/positive communication	7	8	10	4	2	31
4.	Better training technology/materials	10	2	6	12	1	31
5.	More malfunction analysis and "work around" procedures training	18	2	9	2	0	31
6.	Better scheduling	3	6	8	0	2	19
7.	Tailor flight to aircrews' needs	1	9	7	1	1	19
8.	More experienced/better use of	8	1	4	1	5	19
9.	Better aircraft/simulator maintenance	0	2	11	4	1	18
10.	More air refueling/low level bomber training	2	14	2	0	0	18
11.	More offensive avionics station training	9	4	2	2	0	17
12.	More efficient use of simulator time	4	0	8	3	0	15
13.	Realistic weapons/aircrew interface training	5	2	6	2	0	15
14.	More efficient use of flight time	0	9	0	0	5	14
15.	More emergency procedures training	11	0	3	0	0	14
16.	More realistic hostile environment training	4	4	2	1	2	13
17.	More emergency war order training	4	2	5	0	2	13
18.	More alternative navigation procedures training	8	2	2	0	0	12
19.	Less extra crewmen on Pro sorties - No double navigation	3	6	0	0	3	12
20.	More local instrument flight rule routes	0	10	0	0	0	10
21.	More celestial navigation training	2	7	1	0	0	10
22.	More realistic duration of missions	0	8	0	0	2	10
23.	More flying time	4	2	0	2	1	9
24.	More enemy weapons, tactics training	3	2	1	0	1	7
25.	More crew coordination training	1	0	4	0	2	7
26.	More aircraft systems training	4	0	0	2	1	7
27.	More enroute cell formation training	4	2	0	0	0	6
28.	More basic navigation training	3	1	1	0	0	5
29.	Decrease items that can be simulated (e.g., long navigation legs)	0	5	0	0	0	5
30.	More live conventional drops and nuclear shapes	2	2	0	0	0	4
31.	More mission planning	2	0	1	0	1	4
32.	More tactical missions	1	0	0	1	1	3
33.	Standardization between combat crew training squadron and operational units	2	0	0	0	0	2
34.	Emphasize emergency war order, not operational readiness inspection	0	0	0	0	0	0
35.	More minimum interval takeoff procedures training	1	0	1	0	0	2
36.	More enroute refueling with fighter aircraft	1	0	0	0	0	1

Table B-3. SAC B-52 - Electronic Warfare Officer (N = 93)

Category	Page 4 questions					
	1	2	3	4	5	T
1. Better maintenance/fidelity on simulators (weapon system trainers (WSTs))	9	1	30	14	8	62
2. Other	12	13	8	9	3	50
3. Integrate WSTs in syllabus	22	3	5	10	4	44
4. Keep T4 electronic warfare officer trainer with WSTs	8	0	7	14	4	33
5. More threats and emitters along routes, instrument flight rules, strategic training routes, and main operating bases	7	16	1	2	2	28
6. No change	2	0	10	9	4	25
7. More electronic warfare officer training	6	5	4	2	1	18
8. More efficient use of flight time	2	13	1	0	0	16
9. More realistic hostile environment training	6	5	1	0	3	15
10. More crew coordination training	5	2	3	1	3	14
11. Use current threats - updated	6	1	3	2	1	13
12. Updated regulations, etc., readily available	10	0	1	2	0	13
13. More feedback/longer debriefs	3	4	1	2	2	12
14. More instructors	2	1	1	3	5	12
15. Shorter missions, academics	0	11	0	0	1	12
16. More enemy weapons, tactics training	6	0	2	2	1	11
17. More instructor electronic warfare officer training in flight	4	2	0	1	3	10
18. Install signal emitter in local area	0	3	0	3	1	7
19. More emphasis on defending aircraft	3	0	1	1	2	7
20. More realistic weapons/crew training	1	1	1	2	2	7
21. More training aids for self-pace	3	0	1	3	0	7
22. Run mission profile on WSTs prior to mission	1	0	5	0	0	6
23. More academics	3	1	0	1	0	5
24. More "hands on" training	1	0	3	1	0	5
25. More fighter intercept exercise activity	2	3	0	0	0	5
26. More diversity in mission	1	1	0	0	3	5
27. More realistic duration of flights	0	3	1	0	0	4
28. More low level bombing training with fighters	1	3	0	0	0	4
29. More emergency/safety training	0	0	1	0	1	2
30. Better selection standards	2	0	0	0	0	2
31. Integrate academics into flight	0	0	0	1	1	2
32. Tailor flight to aircraft needs	1	0	1	0	0	2
33. More malfunctions and "work around" training	0	0	1	1	0	2
34. More flight time	1	0	1	0	1	2

Table B-4. SAC B-52 - Gunner (N = 115)

	Category	Page 4 questions 1	2	3	4	5	T
1.	More fighter intercept exercise activity	24	30	2	2	5	63
2.	Other	4	5	6	15	12	42
3.	Integrate weapon system trainers (WSTs) in syllabus	7	6	14	7	6	40
4.	More training aids	1	0	3	23	1	28
5.	None	7	1	1	10	9	28
6.	More crew coordination training aircraft	10	6	8	0	3	27
7.	More realistic hostile environment training	13	7	3	2	2	27
8.	No change	4	4	14	3	1	26
9.	More emphasis on defending aircraft	13	3	2	3	1	22
10.	More experienced/better use of	4	2	1	6	5	18
11.	Better aircraft/simulator maintenance	0	1	11	4	0	16
12.	More low level bombing training with fighters	7	7	0	0	2	16
13.	More "hands on" training	9	2	0	3	1	15
14.	More fireout training	6	8	0	0	1	15
15.	More efficient use of non-flight time	0	11	4	0	0	15
16.	More realistic training equipment	2	1	10	0	0	13
17.	Tailor flight to aircrews needs	1	5	5	1	1	13
18.	Realistic weapons/aircrew training	5	2	3	1	1	12
19.	Use WSTs to demonstrate prior to flight	1	4	3	2	2	12
20.	More systems knowledge/academics	3	1	1	2	4	11
21.	Better balanced schedules	2	3	2	1	2	10
22.	More realistic duration of missions	1	5	3	0	1	10
23.	More enemy weapons/tactics training	4	3	1	2	0	10
24.	More electronic warfare officer/gunner coordination training	3	4	2	0	0	9
25.	Shorter missions	0	7	1	0	0	8
26.	More malfunction analysis and "work around" procedures training	2	0	2	2	1	7
27.	Better (higher) selection standards	2	1	0	0	3	6
28.	Debrief with the fighter pilots	1	1	0	3	0	5
29.	More efficient use of flight time	1	3	0	0	1	5
30.	More electronic warfare officer training	2	1	2	0	0	5
31.	More enroute rendezvous with fighter	0	4	0	0	0	4
32.	More feedback	0	0	0	0	2	2
33.	Utilize wasted time with training programs	0	2	0	0	0	2
34.	Add fighter recognition to syllabus	0	0	0	1	0	1
35.	More diversity in sorties	0	1	0	0	0	1

Table 8-5. SAC KC-135 - Pilot/Copilot (N = 171)

Category	Page 4 questions					
	1	2	3	4	5	T
1. Increased access to simulator (weapon system trainer (WST), T-40, cockpit procedures trainer (CPT))	38	7	61	75	6	187
2. More flying time	49	11	1	7	17	85
3. More efficient use of flight/simulator time	15	40	7	3	1	66
4. Better training technology materials	6	0	24	22	5	57
5. No change/positive comment	8	27	13	2	0	50
6. More off-station (strange field) training	9	23	0	0	4	36
7. More/better emergency procedures training	15	1	12	4	3	35
8. Better maintenance on simulator/WST CPT	7	0	21	3	0	31
9. Other content changes	7	9	3	3	8	30
10. More/better crew coordination training	7	8	8	0	5	28
11. Fewer students; more/better use of instructors	9	6	3	5	5	28
12. More aircraft systems training	9	1	6	2	4	22
13. More reliable/simplified calculator/computer programs for performance computation	6	0	1	10	2	19
14. More proficiency hours	11	3	0	0	5	19
15. Coordinated aerial refueling on different tracks with different receivers	1	14	0	0	1	16
16. Add simulator with visual system	3	0	2	11	0	16
17. More/better academics	8	0	1	2	4	15
18. Other administrative change	4	3	1	0	6	14
19. More electronic warfare officer system training	12	1	0	0	0	13
20. More/better copilot training	7	5	0	0	0	12
21. Access to special function trainer	1	0	1	9	0	11
22. Better use of time spent on alert	6	0	2	1	2	11
23. Better continuity in training program	5	1	1	0	2	9
24. Better understanding of command (regulations)	6	1	0	0	1	8
25. More instrument flight time	0	3	3	1	0	7
26. Access to inertial navigation system digital navigation system mockup	0	0	1	6	1	7
27. Other methods procedures	1	2	1	0	3	7
28. Extend training program	3	1	0	0	1	5
29. Shorter local missions	0	2	3	0	0	5
30. More/better pre/post-mission planning	1	1	1	0	2	5
31. Less additional non-flying duties	2	0	0	0	3	5
32. More segmented cell training	2	2	1	0	0	5
33. Better/longer off-load training	2	1	0	0	0	3
34. More minimum interval takeoff procedures training	2	1	0	0	0	3

Table B-6. SAC KC-135 - Navigator (N = 132)

Category	Page 4 questions 1	2	3	4	5	T
1. Integrate weapon system trainer into syllabus	17	3	34	32	8	94
2. Better/more efficient use of flight time/simulator time	13	40	9	1	7	70
3. More flying time	34	14	5	4	8	65
4. More computer-based training device hours	3	5	22	9	2	41
5. More/better emergency procedures training/ systems training	13	5	5	13	3	39
6. More/better training technology/materials	10	2	6	12	2	32
7. More rendezvous per training sortie	9	14	5	0	3	31
8. Better crew coordination	8	3	6	9	5	31
9. More/better use of special function trainer/visual aids/part-task trainer	6	3	12	8	1	30
10. More experienced/better use of instructors	10	5	2	5	7	29
11. No change/positive comment	3	12	6	5	0	26
12. Other administrative change	8	4	3	2	6	23
13. More/better academics	7	0	6	5	5	23
14. More overwater/off-station training procedure time	3	10	1	1	5	20
15. Coordinated aerial refueling on different tracks with different receivers	5	13	0	0	2	20
16. More/better electronic warfare officer training	12	0	1	2	0	15
17. More basic celestial navigation legs	6	5	3	0	0	14
18. Better radar navigation procedures/training	3	0	1	8	1	13
19. More follow-on training and tracking after combat crew training squadron training	3	3	4	1	2	13
20. More/better alert procedure training	9	0	1	0	2	12
21. More use of navigation trainers (T-10, T-45)	1	1	2	5	2	11
22. Inertial navigation system/digital navigation system training aids/mockups	3	1	0	6	0	10
23. More calculators for celestial navigation	2	0	3	4	0	9
24. More segmented cell training	4	3	2	0	0	9
25. More mission planning	4	1	1	0	2	8
26. More empnasis on minimum interval takeoff procedures, trainers	2	1	1	0	0	4

Table B-7. SAC KC-135 - Boom Operator (N = 152)

Category	Page 4 questions					
	1	2	3	4	5	T
1. More access to simulator	1	0	38	18	0	57
2. More efficient use of flight time	15	30	4	4	2	55
3. More "hands on" experience with a realistic cargo loading platform	12	1	0	31	10	54
4. More flying time	30	8	1	1	7	47
5. More/greater diversification in aerial refueling receivers	10	28	2	1	5	46
6. No change/positive comment	16	6	8	7	8	45
7. More/better technology/materials	7	1	11	17	2	38
8. More off-station aerial refueling tracks	8	24	1	0	2	35
9. More/better academics/training materials	15	0	1	9	6	31
10. Other administrative change	7	8	1	5	7	28
11. More emergency procedures practice/study/instruction	6	6	7	4	1	24
12. More/better use of instructors	7	5	2	3	6	23
13. More empnasis on crew coordination	6	6	3	3	4	22
14. Access to special function trainer	0	0	2	16	2	20
15. More heavy weight off-loads	4	13	0	0	0	17
16. More better systems training	6	1	2	5	1	15
17. More segmented cell training	5	4	2	0	1	12
18. More practice of gear and flap lowering procedures	2	3	0	5	1	11
19. Better use of time spent on alert	4	0	0	1	2	7
20. More/better alert preparation/training	5	0	0	0	1	6

Table B-8. MAC C-130 - Pilot/Copilot (N = 178)

	Category	Page 4 questions 1	2	3	4	5	T
1.	No change/positive comment	17	28	82	10	13	150
2.	More simulator time	8	7	44	13	0	72
3.	Other administrative change	14	15	9	7	11	56
4.	Add simulator with visual system	5	2	17	25	2	51
5.	More realistic training	26	11	6	4	1	48
6.	Better scheduling	6	16	16	3	3	44
7.	Shorter local missions	2	2	0	0	0	43
8.	More tactical missions	24	6	3	2	1	39
9.	Better training technology/materials	5	0	4	28	2	39
10.	More hostile environment training	21	7	1	1	2	32
11.	Better use of flying time	6	11	2	5	2	28
12	More/better emergency procedures training	3	2	18	3	0	26
13.	Other content changes	4	7	8	5	1	25
14.	More enemy weapons/tactics training	17	2	1	2	1	23
15.	More flexible routes	11	8	1	1	2	23
16.	More flying time	10	9	3	1	0	23
17.	More variety in aircraft training	7	8	2	1	3	21
18.	More single-ship routes	11	6	0	3	0	20
19.	Better maintenance	6	4	1	3	5	19
20.	Better continuity in training program	6	4	2	1	2	15
21.	More proficiency hours	4	4	2	2	2	14
22.	More aircraft system training	3	0	4	4	2	13
23.	Increase qualifying hours for copilot	3	1	0	1	6	11
24.	More visual flight rules	6	3	1	0	1	11
25.	Better pre-mission training	3	4	1	1	2	11
26.	Other methods/procedures	2	3	3	1	0	9
27.	Fewer students; more planes	3	3	0	1	0	7
28.	More attention to new individuals	2	1	0	0	1	4
29.	More navigation/radio system training	1	0	0	2	0	3
30.	More flight planning	2	0	0	1	0	3
31.	More/better academics	3	0	0	0	0	3
32.	Use number hours rather than number flights	2	0	0	0	0	2
33.	More crew coordination training	0	0	1	0	1	2
34.	More efficient use of flight time	1	1	0	0	0	2

Table B-9. MAC C-130 - Navigator (N = 105)

Category	Page 4 questions 1	2	3	4	5	T
1. More simulator time	7	4	26	3	3	43
2. More realistic/hostile environment	20	14	2	2	1	39
3. Better trainers/resources/materials	4	1	7	21	3	36
4. More special drops	6	13	3	2	2	26
5. More over-water missions	9	9	2	1	3	24
6. Other administrative change	4	5	2	6	5	22
7. Require Form 512s less frequently (airdrops)	1	9	3	6	2	21
8. More experienced instructors/better use of	9	2	2	1	5	19
9. More basic navigation training	8	1	4	3	2	18
10. More or better used flight time	10	5	0	1	2	18
11. Other methods/procedures change	1	5	3	4	5	18
12. More celestial navigation training	3	1	3	7	0	14
13. More crew coordination training	6	3	3	2	0	14
14. Improved station-keeping equipment training	4	2	5	1	0	12
15. Change in course syllabus	2	2	2	1	1	8
16. More verbally initiated release system, ground mark release system, ground release air delivery system, and radar beacon drops	1	3	1	2	0	7
17. More publications/academics	2	1	0	3	1	7
18. Have primary instructors	4	0	0	1	2	7
19. More systems training	3	1	1	1	0	6
20. More map reading/doppler training	2	1	1	1	1	6
21. Other content changes	2	1	1	0	2	6
22. More knowledge of pilot's job	4	0	0	1	0	5
23. More all-weather aerial delivery system	1	0	1	2	1	5
24. More realistic duration of missions	1	4	0	0	0	5
25. More mission planning	1	0	0	0	4	5
26. Better maintenance/scheduling	5	0	0	0	0	5
27. More emergency procedures training missions	2	0	1	0	1	4
28. More OMEGA (AN/ARN 131) navigation operations	0	0	1	3	0	4
29. More airborne radar approaches	1	1	0	1	0	3
30. More night missions	0	2	1	0	0	3
31. More terminal enroute procedures training	1	0	0	0	1	2
32. More weather radar procedures	0	0	0	1	0	1
33. Realistic continuation training program	0	0	1	0	0	1

Table B-10. MAC C-130 - Flight Engineer (N = 105)

	Category	Page 4 questions 1	2	3	4	5	T
1.	No change/positive comment	14	21	27	15	3	80
2.	More efficient use of flight time	2	28	1	0	1	32
3.	More aircraft systems training	19	1	1	4	3	28
4.	Other administrative change	5	1	2	11	6	25
5.	More realistic combat training	15	5	1	0	2	23
6.	More emergency procedures training	4	6	8	3	2	23
7.	More simulator training time	5	3	12	0	2	22
8.	More hands-on training	4	2	2	11	2	21
9.	Better scheduling	2	5	7	1	4	19
10.	Better mockups/field training devices	1	0	0	16	0	17
11.	More microcomputerized training	1	0	0	9	2	12
12.	More coordination - simulator to aircraft	1	1	7	0	1	10
13.	Other method/procedure change	0	0	7	2	0	9
14.	More academics	3	0	1	2	2	8
15.	Better maintenance	2	1	1	2	2	8
16.	Retain experienced instructors	4	0	1	1	2	8
17.	More crew coordination	1	4	1	0	1	7
18.	More takeoff and landing data instruction	5	0	0	1	0	6
19.	Better delivery tactics training	3	2	0	0	1	6
20.	Better communication - instruction to field	4	0	1	0	1	6
21.	Less formation flying	4	1	0	0	0	5
22.	More ground school	3	0	0	0	2	5
23.	More knowledge of other crew positions	3	1	0	0	0	4
24.	More flying hours	1	2	0	0	1	4
25.	Train two flight engineers jointly	1	1	1	0	1	4
26.	Better refresher training	3	0	0	0	1	4
27.	Better lesson plans	1	0	0	1	2	4
28.	Better proficiency testing	0	1	0	2	1	4
29.	More instrument training	0	0	2	0	1	3
30.	Other content change	1	1	1	0	0	3
31.	Clarify training upgrade policy	3	0	0	0	0	3
32.	Replace station-keeping equipment with better system	2	0	0	0	0	2
33.	More varied routes	1	1	0	0	0	2
34.	More cross-training	1	0	0	0	0	1

Table B-11. MAC C-130 - Loadmaster (N = 107)

	Category	Page 4 questions 1	2	3	4	5	T
1.	Use actual equipment loads	14	7	5	2	0	28
2.	More efficient use of flight time	17	2	0	1	0	20
3.	No change/positive comment	5	4	3	6	0	18
4.	More combat-related training	8	2	2	4	1	17
5.	More realistic scheduling	4	9	0	1	0	14
6.	More hands-on training	2	4	4	2	0	12
7.	More microcomputer trainers	1	1	6	1	1	10
8.	Better qualification standards	2	1	4	2	1	10
9.	Better maintenance	0	1	3	3	3	10
10.	More local missions	7	1	0	1	0	9
11.	Other administrative change	0	0	2	4	0	6
12.	More emergency procedures training	2	0	3	0	0	5
13.	More coordination training with Army	2	1	1	1	0	5
14.	More chains and rolling stock	0	2	0	2	0	4
15.	Better training on regulations	1	0	0	2	0	3
16.	Other method/procedure changes	0	0	2	0	1	3
17.	More aircraft systems training	0	1	1	0	0	2
18.	Other content changes	0	1	1	0	0	2
19.	More time with students	0	1	0	1	0	2
20.	Expand training programs	0	1	1	0	0	2
21.	More personnel airdrops	1	0	1	0	0	2
22.	More one-on-one training	0	1	0	0	0	1
23.	More flying hours	1	0	0	0	0	1
24.	Increase manning allocations	0	0	0	0	1	1
25.	Improve instructor rotations	0	0	0	1	0	1

Table B-12. MAC C-141 - Pilot/Copilot (N = 137)

	Category	Page 4 questions 1	2	3	4	5	T
1.	Present training acceptable	15	18	24	10	8	75
2.	Develop special function trainers	4	1	1	27	6	39
3.	Develop more realistic simulator	6	2	9	17	2	36
4.	Allocate local available flying hours based on needs of aircrew training	12	17	0	1	2	32
5.	More available hours for simulator	0	2	22	0	0	24
6.	More local flights for upgrade	2	15	0	0	0	17
7.	More aircraft systems training	4	3	1	5	2	15
8.	Less malfunction training in simulator, more flying training in simulator	0	0	12	0	0	12
9.	More critical malfunction training in simulator	0	2	9	0	0	11
10.	Better reliability for simulator	1	0	7	0	1	10
11.	Self-paced workbooks	3	0	0	5	2	10
12.	Use pilot as instructor for copilots	4	2	0	1	2	9
13.	More flying hours	6	2	0	0	0	8
14.	Better scheduling	1	3	1	2	0	7
15.	More strange field approaches	0	6	0	0	0	6
16.	Better flight publications training for overseas missions	1	1	0	1	2	5
17.	More air refueling training	2	3	0	0	0	5
18.	Eliminate cockpit procedures trainer	1	0	3	0	0	4
19.	More continuity between simulators and flying	2	2	0	0	0	4
20.	More seminars for study sessions	2	1	0	1	0	4
21.	More mission-oriented simulator training	1	0	3	0	0	4
22.	Reduce aircrew workload for additional duties	2	1	0	0	1	4
23.	Contractor aircrew training at Altus AFB	1	0	0	2	0	3
24.	Eliminate aircraft commander school	0	0	0	0	3	3
25.	Fewer mandatory training events	1	0	0	0	2	3
26.	Train pilots separately while conducting flight engineer training in simulator	0	0	3	0	0	3
27.	More emphasis on integral aircrew	1	1	0	0	0	2
28.	More instruction in flight planning and fuel planning	1	0	0	1	0	2
29.	More realistic proficiency standard	1	0	0	0	1	2
30.	More station-keeping equipment training	0	0	1	1	0	2
31.	Train instructors to teach, not evaluate	1	0	0	0	1	2
32.	Upgrade to pilot based on ability, not flying hours	1	0	0	1	0	2

Table B-13. MAC-C-141 - Navigator (N = 73)

Category	Page 4 questions 1	2	3	4	5	T
1. More realistic training sorties	8	12	2	1	3	26
2. Develop special function trainer	2	0	2	11	4	19
3. More flying hours	3	4	1	0	1	9
4. More training in aircraft systems	2	0	3	1	1	7
5. More training in single-ship airdrop	3	2	0	0	0	5
6. More training in station-keeping equipment	1	0	0	4	0	5
7. Defer single-ship qualification for local unit training	2	1	0	0	2	5
8. More threat analysis and intelligence briefings	2	2	0	1	0	5
9. More visual flight rules training	0	1	1	1	1	4
10. Observe pilot missions and systems operation in simulator	0	0	4	0	0	4
11. Provide programmable calculator with standardized computation programs	0	0	4	0	0	4
12. More training in fuel planning	2	0	0	0	1	3
13. Refresher material in workbook form	1	1	0	1	0	3
14. Publish navigator's specific responsibilities and tasks	1	0	0	1	1	3
15. Increase length of training time at Altus AFB	3	0	0	0	0	3
16. More training in monitoring instrument departure approach	1	1	0	0	1	3
17. More training in computation of high-altitude release point and computed altitude release point	2	0	0	0	1	3
18. More combat aircrew training	1	1	0	1	0	3
19. More hours in cockpit procedures trainer (CPT)	1	0	1	0	0	2
20. More hours in weapon system trainer (WST)	1	0	1	0	0	2
21. Develop multi-ship visual capability for WST	0	0	1	1	0	2
22. Use WST for inertial navigation system/emergency malfunctions	0	0	2	0	0	2

Table B-14. MAC C-141 - Flight Engineer (N = 121)

Category	Page 4 questions 1	2	3	4	5	T
1. Use of mock-ups/cockpit procedures trainers/special function trainers	2	0	3	15	9	29
2. More classrooms and academics	10	1	2	6	5	24
3. More simulator time	4	0	13	2	2	21
4. Use of computer-assisted instruction/video/computers in training	3	2	0	9	5	19
5. Adequate as is	4	5	5	4	0	18
6. Better selection methods/upgrade standards	8	2	1	4	3	18
7. More instructor involvement/improve quality	2	4	2	4	5	17
8. Other	5	4	2	2	1	14
9. More flying time	3	5	1	3	1	13
10. More hands-on training	3	0	1	5	4	13
11. Tailor training to aircrew needs	2	3	4	1	2	12
12. More realism in simulated missions	7	1	2	0	1	11
13. Standardize and upgrade training syllabus	6	0	2	1	2	11
14. Better training schedules	2	2	3	2	1	10
15. Better use of flying time	3	2	2	1	2	10
16. More variety on simulated missions	3	1	2	1	1	8
17. Better simulator maintenance	0	1	2	2	2	7
18. Teach crew coordination	3	1	3	0	0	7
19. Utilize wasted time	2	3	1	1	0	7
20. More procedures training	3	0	3	0	0	6
21. More refresher courses	3	0	1	1	1	6
22. Discontinue simulator time for checkrides	1	0	3	0	1	5
23. Have longer missions	1	4	0	0	0	5
24. Use of simulators for refresher course	2	0	2	1	0	5
25. More emergency training	2	0	2	0	0	4
26. Place training at squadron level	2	0	1	1	0	4
27. Add visuals to simulation	2	0	0	1	1	4

Table B-15. MAC C-141 - Loadmaster (N = 102)

Category	Page 4 questions 1	2	3	4	5	T
1. Hands-on training	11	1	2	8	5	27
2. More trainers/simulators	1	2	12	9	2	26
3. Adequate as is	5	6	3	2	6	22
4. Better selection/upgrading standards	6	3	0	2	6	17
5. Higher fidelity	3	0	6	4	4	17
6. Other comments	2	3	3	3	2	13
7. Utilize wasted time	4	5	2	2	0	13
8. More classroom	3	3	1	2	9	12
9. More combat aircrew training	8	2	1	0	1	12
10. More instructors	3	2	0	1	3	9
11. More realistic sorties	0	3	2	3	1	9
12. Tailor flights to aircrew needs	4	4	0	0	1	9
13. Update simulators/training programs	0	0	2	2	5	9
14. Use of mock-ups	0	0	1	6	2	9
15. Variety of cargo/missions	1	6	2	0	0	9
16. Use of local/line missions more adequately	3	4	0	0	1	8
17. More flying	0	3	1	2	1	7
18. Practice	4	1	0	1	1	7
19. Better training schedule	0	4	1	1	0	6
20. Teach crew coordination/supervision	1	0	0	2	3	6
21. Put training at squadron level	2	0	0	1	2	5
22. Use of computers	0	0	0	4	1	5
23. Make required procedures clearer	2	0	1	0	1	4
24. More instructor involvement	2	1	0	0	1	4
25. More study guides/work books/video	0	0	1	1	2	4
26. Low level/airdrop training	0	1	1	0	1	3

END

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